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L2: Entry 1 of 2 File: USPT

US-PAT-NO: 4609563
DOCUMENT-IDENTIFIER: US 4609563 A

TITLE: Metered charge system for catalytic coating of a substrate

DATE-ISSUED: September 2, 1986

INVENTOR-INFORMATION:

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US-CL-CURRENT: 427/8; 118/50, 118/50.1, 427/238, 427/243, 427/294, 427/443.2, 502/439, 502/514

CLAIMS:

We claim:

1. A process for applying a predetermined amount of catalyst to the interior surfaces of a hollow substrate comprising the steps of:

introducing a predetermined amount of catalyst slurry into the cavity of a dip pan having a bottom;

lowering a hollow substrate having first and second open ends and interior surfaces to be coated such that a first end is received in the cavity of the dip pan and fully immersed in the slurry;

maintaining the substrate at a height such that the first end thereof is ~~located at a predetermined~~ distance above the bottom of the cavity in the dip pan;

applying a vacuum from a source to the second end of the substrate to draw all of the slurry contained in the dip pan upwardly into the substrate for coating the interior surfaces thereof; and

continuing to apply vacuum for a predetermined period of time to the second end of the substrate after all of the slurry has been drawn out of the dip pan and into the substrate for drying the coating formed on the substrate.

2. A process as set forth in claim 1 comprising the additional steps of:

raising the substrate to a dwell height such that the ends thereof clear, respectively, the dip pan and the source of the vacuum;

rotating the substrate to reverse the relative positions of the first and second ends thereof;

again introducing a predetermined amount of slurry into the cavity of the dip pan;

lowering the substrate so that the second end is received in the cavity of the dip pan and immersed in the slurry;

maintaining the substrate at a height such that the second end thereof is located at a predetermined distance above the bottom of the cavity in the dip pan;

applying a vacuum from the source to the first end of the substrate to draw all of the slurry within the dip pan upwardly into the substrate for coating the interior surface thereof; and

continuing to apply vacuum for a predetermined period of time to the first end of the substrate after all of the slurry has been drawn out of the dip pan and into the substrate for drying the coating formed on the substrate.

3. A process as set forth in claim 2 comprising the additional steps of:

withdrawing the source of the vacuum from the first end of the substrate;

again raising the substrate to a dwell height such that the ends thereof clear, respectively, the dip pan and the source of the vacuum; and

rotating the substrate to return the first and second ends thereof to their original relative orientation.

4. A process for applying a predetermined amount of catalyst to the interior surfaces of a hollow substrate comprising the steps of:

introducing a predetermined amount of catalyst slurry into the cavity of a dip pan having a bottom;

lowering a hollow substrate having first and second open ends and interior surfaces to be coated such that a first end is received in the cavity of the dip pan and fully immersed in the slurry;

maintaining the substrate at a height such that the first end thereof is located at a predetermined distance above the bottom of the cavity in the dip pan;

applying a low initial vacuum and subsequently a high vacuum from a source to the second end of the substrate to draw all of the slurry contained in the dip pan upwardly into the substrate for coating the interior surfaces thereof; and

continuing to apply a high vacuum for a predetermined period of time to the second end of the substrate after all of the slurry has been drawn out of the dip pan and into the substrate for drying the coating formed on the substrate.

5. A process for applying a predetermined amount of catalyst to the interior surfaces of a hollow substrate comprising the steps of:

transferring from an initial position a hollow substrate having first and second open ends and interior surfaces to be coated such that the first end advances towards the cavity of the dip pan adapted to receive therein the first end for full immersion thereof in a catalyst slurry which has been introduced in the cavity;

sensing the orientation of the substrate relative to the dip pan as the first end thereof passes through a plane positioned above the cavity and transverse

to the path of travel of the substrate;

interrupting the transfer of the substrate toward the cavity of the dip pan in the event the substrate is so oriented that the first end cannot properly enter the cavity for immersion in the slurry; and

returning the substrate to the initial position after interrupting the transfer of the substrate toward the cavity of the dip pan.

6. A process for applying a predetermined amount of catalyst to the interior surfaces of a hollow substrate comprising the steps of:

introducing a predetermined amount of catalyst slurry into the cavity of a dip pan having a bottom;

transferring from an initial position a hollow substrate having first and second open ends and interior surfaces to be coated such that the first end advances towards the cavity of the dip pan adapted to receive therein the first end for full immersion thereof into the catalyst slurry;

sensing the presence of the substrate as the first end thereof passes through a plane positioned above the cavity and lying transverse to the path of travel of the substrate;

terminating movement of the substrate when the first end thereof reaches an operative position a predetermined distance above the bottom of the cavity and fully immersed in the catalyst slurry.

7. A process for applying a predetermined amount of catalyst to the interior surfaces of a hollow substrate comprising the steps of:

introducing a first predetermined amount of catalyst slurry into the cavity of a dip pan;

lowering a hollow substrate having first and second open ends and interior surfaces to be coated such that a first end is received in the cavity of the dip pan and fully immersed in the slurry;

applying a vacuum to the second end of the substrate to draw all of the slurry contained in the dip pan upwardly into the substrate through the first end for coating the interior surfaces thereof;

withdrawing the source of the vacuum from the second end of the substrate;

raising the substrate to a dwell height such that the ends thereof clear, respectively, the dip pan and the source of the vacuum;

rotating the substrate to reverse the relative positions of the first and second ends thereof;

introducing a second predetermined amount of slurry into the cavity of the dip pan;

lowering the substrate so that the second end thereof is received in the cavity of the dip pan and fully immersed in the slurry; and

applying a vacuum to the first end of the substrate to draw all of the slurry contained in the dip pan upwardly into the substrate through the second end for coating the interior surfaces thereof.

8. A process for introducing a predetermined amount of catalyst slurry into a dip pan for use in coating the interior surfaces of a hollow substrate

comprising the steps of:

causing flow of the slurry from a reservoir into a bladder means; continuously weighing the bladder means as slurry is received therein;

terminating flow of the slurry into the bladder means when the weight of the slurry therein reaches a predetermined magnitude; and

subsequently releasing all of the slurry in the bladder means and causing it to flow into the dip pan in preparation for coating the interior surfaces of the substrate.

9. A process for introducing a predetermined amount of catalyst slurry into a dip pan for use in coating the interior surfaces of a hollow substrate comprising the steps of:

causing flow of the slurry from a reservoir into a bladder means;

terminating flow of the slurry into the bladder means when the volume of the slurry therein reaches a predetermined magnitude; and

subsequently releasing all of the slurry in the bladder means and causing it to flow into the dip pan in preparation for coating the interior surfaces of the substrate.

10. A process as set forth in claim 1 wherein the predetermined amount called for in the step of introducing catalyst slurry into the cavity of the dip pan is a predetermined volume of the slurry.

11. A process as set forth in claim 1 wherein the predetermined amount called for in the step of introducing catalyst slurry into the cavity of the dip pan is a predetermined weight of the slurry.

12. A process for applying a predetermined amount of catalyst to the interior surfaces of a hollow substrate comprising the steps of:

placing a substrate to be coated onto a platform within the confines of a clamp selectively operable to firmly engage and support the substrate;

operating the clamp to firmly engage and support the substrate;

raising the clamp and supported substrate above the platform to a first dwell position;

translating the clamp and supported substrate to a second dwell position in vertical alignment with and between a vacuum cone and a dip pan having a cavity for receiving catalyst slurry therein;

introducing a predetermined amount of catalyst slurry into the cavity of the dip pan;

lowering the clamp so that a first end of the supported substrate is received in the cavity of the dip pan;

sensing the presence of the substrate as the first end thereof passes through a plane positioned above the cavity and lying transverse to the path of travel of the substrate;

terminating movement of the clamp when the first end of the substrate reaches an operative position a predetermined distance above the bottom of the cavity and is immersed in the catalyst slurry;

simultaneously with the step of lowering the clamp, lowering the vacuum cone into sealing engagement with a second end of the substrate opposite the first end thereof when the first end is at the operative position;

applying a vacuum to the vacuum cone to draw the catalyst slurry in the cavity completely into the first end of the substrate in order to coat the interior surfaces thereof nearest the first end;

continuing for a predetermined period to apply vacuum to the vacuum cone while raising the clamp, the substrate, and the vacuum cone as a unit to the second dwell position at which the first end is clear of obstruction with the dip pan thereby drying the coating of the catalyst slurry on the interior surfaces of the substrate;

discontinuing the application of vacuum to the vacuum cone;

withdrawing the vacuum cone to a retracted position distant from the clamp and the substrate;

rotating the clamp about an axis so as to shift the respective positions of the first and second ends of the substrate;

again introducing a predetermined amount of catalyst slurry into the cavity of the dip pan;

lowering the clamp so that the second end of the substrate is received in the cavity of the dip pan;

sensing the presence of the substrate as the second end thereof passes through a plane positioned above the cavity and transverse to the path of travel of the substrate;

terminating movement of the clamp when the second end of the substrate reaches an operative position a predetermined distance above the bottom of the cavity and is fully immersed in the catalyst slurry;

simultaneously with the step of lowering the clamp, again lowering the vacuum cone into sealing engagement with the first end of the substrate when the second end is at the operative position;

applying a vacuum to the vacuum cone to draw the catalyst slurry in the cavity completely into the second end of the substrate in order to coat the interior surfaces thereof nearest the second end;

continuing for a predetermined period to apply vacuum to the vacuum cone while raising the clamp, the substrate, and the vacuum cone as a unit to the second dwell position thereby drying the coating of the catalyst slurry on the interior surfaces of the substrate;

discontinuing the application of vacuum to the vacuum cone;

withdrawing the vacuum cone to a retracted position distant from the clamp and the substrate;

again rotating the clamp about an axis so as to shift the respective positions of the first and second ends of the substrate;

translating the clamp and supported substrate for return to the first dwell position;

lowering the clamp so that the first end is again brought to rest onto the platform; and

disengaging the clamp from the substrate.

13. Apparatus for applying a predetermined amount of catalyst to the interior surfaces of a hollow substrate comprising:

clamp means firmly engaging and supporting a hollow substrate having opposed open first and second ends;

a dip pan having a cavity with a bottom for holding a predetermined amount of catalyst slurry therein and adapted to receive therein an end of the substrate;

first drive means for moving said clamp means upwards and downwards along a generally upright path aligned with the cavity of said dip pan; and

control means for controlling movement of said first drive means along said upright path and including sensing means for detecting the presence of a first end of the substrate as it approaches said dip pan when said clamp and supported substrate are moved downwardly along said upright path, said control means being operable to terminate downward movement of said first drive means when the first end of the substrate reaches a position fully immersed in the slurry and located a predetermined distance above the bottom of said dip pan.

14. Apparatus as set forth in claim 13 including a vacuum cone and a conduit operatively connecting said vacuum cone to a source of vacuum, said vacuum cone having an open end movable between a retracted position distant from the second end of the substrate and an extended position for sealingly enveloping the second end of the substrate when the first end of the substrate is immersed in the slurry.

15. Apparatus as set forth in claim 14 wherein said vacuum cone is engagable with said clamp for sealingly enveloping the second end of the substrate and includes sealing means for effectively sealing the interface between said vacuum cone and said clamp when they are engaged.

16. Apparatus as set forth in claim 15 wherein said vacuum cone is bell shaped and terminates at a rim, said sealing means being a continuous gasket mounted on said rim and engageable with said clamp whereby a broad range of sizes of substrates can be accommodated.

17. Apparatus as set forth in claim 14 including second drive means for moving said vacuum cone between said retracted and extended positions, said control means being effective to operate said first and second drive means such that said vacuum cone sealingly envelopes the second end of the substrate at substantially the same time that the substrate on said clamp enters the slurry in said dip pan.

18. Apparatus as set forth in claim 14 wherein said source of vacuum is selectively operable alternatively at a low level of vacuum and at a high level of vacuum and wherein said control means is effective to initially operate said source at said low level when said vacuum cone first sealingly envelopes said substrate and at said high level after said vacuum cone has sealingly enveloped said substrate for a predetermined period of time.

19. Apparatus as set forth in claim 18 wherein said control means is operable for selectively applying a low vacuum to said vacuum cone when said vacuum cone initially sealingly envelopes the substrate, then for applying a high vacuum to said vacuum cone after said vacuum cone has sealingly enveloped the substrate for a predetermined period of time, and for preventing the application of said high vacuum to said vacuum cone when said vacuum cone is withdrawn from the substrate.

20. Apparatus as set forth in claim 18 wherein said control means is operable

for selectively applying a high volume to said vacuum cone after said vacuum cone has sealingly enveloped the substrate for a predetermined period of time, and for terminating the application of said high vacuum to said vacuum cone when said vacuum cone is withdrawn from the substrate.

21. Apparatus as set forth in claim 20 wherein said control means is operable to move as a unit to a dwell position said clamp and said vacuum cone while said vacuum cone still sealingly envelopes the second end of the substrate such that the substrate is clear of said dip pan and after passage of another predetermined period of time to operate said second drive means to withdraw said vacuum cone from the second end of the substrate and to move said vacuum cone to the retracted position.

22. Apparatus as set forth in claim 21 wherein said control means is operable to move said clamp to a dwell height such that the ends of the substrate clear said vacuum cone and said dip pan in said retracted position and including means for rotating said clamp to thereby reverse the relative positions of the first and second ends of the substrate, said control means being operable to rotate said clamp when said clamp attains said dwell height.

23. Apparatus as set forth in claim 18 wherein said source of vacuum includes a vacuum pump operable across a broad range of speeds to generate a broad range of vacua as a function of speed, and a variable speed motor for driving said vacuum pump whereby operation of said motor at a low speed causes said vacuum pump to generate a low vacuum and whereby operation of said motor at a high speed causes said vacuum pump to generate a high vacuum.

24. Apparatus for applying a predetermined amount of catalyst to the interior surfaces of a hollow substrate having opposed open first and second ends comprising:

clamp means firmly engaging and supporting the hollow substrate;

a dip pan having a cavity with a bottom for holding a predetermined amount of catalyst slurry therein and adapted to receive therein an end of the substrate for immersion in the slurry;

first drive means for moving said clamp means upward and downwards along a generally upright path aligned with the cavity of said dip pan;

control means for controlling movement of said first drive means along said upright path and including sensing means for sensing the presence and orientation of the substrate relative to said dip pan as an end of the substrate passes downwardly through a plane positioned above the cavity and transverse to the path of travel of the substrate;

said control means being operable to permit continued movement of said clamp when the orientation of the substrate is such as to assure that the end thereof will be properly received within the cavity of said dip pan, said control means being operable to terminate operation of said first drive means and therefore downward movement of the substrate when the end thereof reaches an operative position a predetermined distance above the bottom of the cavity and fully immersed in the slurry.

25. Apparatus as set forth in claim 24 wherein said control means interrupts the operation of said first drive means moving said clamp downwardly toward said dip pan when the orientation of the substrate is such that the substrate will not be properly received within the cavity of said dip pan for immersion in the slurry.

26. Apparatus as set forth in claim 24 wherein said sensing means includes at least one signal emitting source and at least one associated detector spaced from said source and positioned such that said upright path lies intermediate

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L2: Entry 2 of 2 File: USPT

US-PAT-NO: 4254158
DOCUMENT-IDENTIFIER: US 4254158 A

TITLE: Process for one-side hot-dip coating

DATE-ISSUED: March 3, 1981

INVENTOR-INFORMATION:

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US-CL-CURRENT: 427/8; 118/410, 427/422, 427/431, 427/432, 427/433, 427/434.3

CLAIMS:

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A process for one-sided, hot-dip coating of a metal sheet in an apparatus including a molten metal bath, a pair of guide rolls disposed above said bath, an electromagnetic pump and at least one nozzle which comprises:

guiding and causing said metal sheet to be coated to travel over said molten metal bath by means of said pair of guide rolls diposed over above said bath;

sucking a hot-dip coating metal inside said molten metal bath by an electromagnetic pump disposed outside said bath and jetting said hot-dip coating metal through said molten metal bath from said at least one nozzle which protrudes beyond the surface of said bath between said pair of guide rolls;

bringing said hot-dip coating metal thus jetted into contact with the lower surface of said metal sheet over its entire range in its transverse direction while said metal sheet is travelling, thereby forming a coating layer of said hot-dip coating metal on the lower surface of said sheet;

measuring the bath surface level by means of a bath surface level detector; and

controlling the input voltage to said electromagnetic pump in response to said step of measuring the bath surface level so as to hold the jet height of said hot-dip coating metal at a constant level.

2. The process for one-sided, hot-dip coating as defined in claim 1 wherein said metal sheet consists of steel sheet.

3. The process for one-sided, hot-dip coating as defined in claim 1 wherein said hot-dip coating metal comprises zinc, aluminum, lead and their alloys.

4. The process for one-sided, hot-dip coating as defined in claim 1 which further comprises holding said hot-dip coating metal, said metal sheet to be coated, said at least one nozzle and said pair of guide rolls in an atmosphere of a reducing gas or of an inert gas shielded from the external air in order to prevent oxidation of said metal sheet and forming said coating layer of said hot-dip coating metal on the lower surface of said metal sheet.

5. The process for one-sided, hot-dip coating as defined in claim 1 which further comprises jetting said hot-dip coating metal by means of said electromagnetic pump at a plurality of positions in the direction of the width of said metal sheet.

6. The process for one-sided, hot-dip coating as defined in claim 1 which further comprises controlling the thickness of the coated film of said metal sheet subjected to one-sided, hot-dip coating by gas wiping.

7. The process for one-sided, hot-dip coating as defined in claim 6 wherein said wiping comprises a reducing gas or an inert gas.

8. A process for one-sided, hot-dip coating of a metal sheet in an apparatus including a molten metal bath, a pair of guide rolls disposed above said bath, an electromagnetic pump and at least one nozzle having a flat mouth extending in the direction of the width of said metal sheet, both end portions of said mouth being expanded more than the central portion of said mouth, which comprises:

guiding and causing said metal sheet to be coated to travel over said molten metal bath by means of said pair of guide rolls disposed above said bath;

sucking a hot-dip coating metal inside said molten metal bath by an electromagnetic pump disposed outside said bath and jetting said hot-dip coating metal through said molten metal bath from said at least one nozzle which protrudes beyond the surface of said bath between said pair of guide rolls such that the jet area of flow of said jet of hot-dip metal is expanded so as to have a width substantially equal to that of said metal sheet; and

bringing said hot-dip coating metal thus jetted into contact with the lower surface of said metal sheet over its entire range in its transverse direction while said metal sheet is travelling, thereby forming a coating layer of said hot-dip coating metal on the lower surface of said sheet.